

446.4.01 Limits

General Provisions 101 through 150.

446.5 Payment

Payment will be made at the Contract Unit Price per square yard (meter) or per linear foot (meter) of reinforcement fabric as shown in Subsection 446.4, "Measurement."

Payment is full compensation for the work specified in this section, including cleaning the surface and furnishing and placing the asphalt cement binder and pavement reinforcement fabric.

Payment will be made under:

Item No. 446	Pavement reinforcement fabric strips, type____ including bituminous binder	Per linear foot (meter)
Item No. 446	Pavement reinforcement fabric full width, type____ including bituminous binder	Per square yard (meter)
Item No. 446	High Strength Pavement Reinforcement Fabric _____ inch (meter) Width	Per linear foot (meter)

446.5.01 Adjustments

General Provisions 101 through 150.

Section 447—Modular Expansion Joints**447.1 General Description**

Specifications for this work will be included elsewhere in the Contract.

Section 448—Portland Cement Concrete End Dams and Patches**448.1 General Description**

Specifications for this work will be included elsewhere in the Contract.

Section 449—Bridge Deck Joint Seals**449.1 General Description**

This work consists of furnishing and installing bridge deck joint sealing systems at the locations shown on the Plans.

These bridge deck joint sealing systems consist of a joint seal and may include concrete headers. Use a joint seal material that conforms to one of the following:

- A preformed elastomeric neoprene profile seal, or
- A low-density, closed cell, cross-linked, ethylene vinyl acetate, polyethylene copolymer, nitrogen-blown seal.

Use either epoxy concrete or elastomeric concrete for header material. Mix and use elastomeric and epoxy concrete material according to the manufacturer's guidelines.

449.1.01 Definitions

General Provisions 101 through 150.

449.1.02 Related References**A. Standard Specifications**

Section 106—Control of Materials

Section 501—Steel Structures

B. Referenced Documents

GDT 111

ASTM A 36
 ASTM D 395
 ASTM D 570
 ASTM D 588
 ASTM D 624
 ASTM D 638
 ASTM D 1299
 ASTM D 2240
 ASTM D 2628
 ASTM D 4070

449.1.03 Submittals

A. Working Drawings

Furnish working drawings covering the proposed joint installation. Before the joint is installed, the Bridge Engineer will review these drawings and indicate this review on the drawings.

The Department is not responsible for the accuracy of the drawings.

Assume responsibility for conforming to the Specifications and Plans. Include these items in the submission:

- Manufacturer's brochure on the proposed joint, showing component physical dimensions, installation procedures, material certifications, and a table of variable temperatures and dimensions
- Drawings that detail the joint installation and indicates the length of component members, treatment of directional changes, and field splicing of steel locking rails
- Expansion joint fabricator documentation

Ensure that the expansion joint fabricator is AISC Category I, shop approved. Supply documentation with the shop drawings.

B. Submissions for Preformed Elastomeric Neoprene Profile Seals

Furnish the manufacturer of the performed elastomeric neoprene profile seal a working drawing for each installation. This drawing shall include all of the following information:

- Identification and orientation of each joint
- Length of each joint including a minimum 6 in (150 mm) turn up at both barrier faces
- Total projected movement range of the joint
- Use a full-length seal if a full bridge width installation can be made. If traffic conditions require that the joint seal installation be in stages, indicate the splice points

In addition to the above, if existing edge beams are to remain as joint headers, furnish the manufacturer of the seal the following:

- Joint width measurements taken at 2 ft (600 mm) intervals along the full length of the joint plus a measurement of the joint width of each barrier in the area of the turn ups
- Ambient temperature, taken when width measurements are made

Have the manufacturer of the preformed elastomeric neoprene profile seal use this information to determine quantities of materials needed and the profile size or sizes for each joint.

Have the manufacturer enter this data on the working drawing, and verify that the data is accurate and submit a copy to the Engineer for review. Show an indication of such verification on the drawings.

Engineer approval is required before installing the joint seal. The Department review will be considered a service to assist the Contractor. The Department will assume no responsibility for the accuracy of the drawings, and the Contractor will not be relieved of any responsibility for conforming to the Specifications and Plans.

449.2 Materials

A. Elastomeric Concrete Material

Elastomeric concrete material includes two-component elastomer and prebagged fillers. Mix the elastomeric concrete material and use it according to the manufacturer's recommendations. This may require using heat to accelerate curing and ensure a quality bond to the concrete and steel.

Use the Elastomeric Concrete Material with these features:

- Compatible with the concrete and steel to which it is bonded
- Smooth riding surface across the joint
- Can be mixed using normal equipment
- Can be mixed and placed between 45 °F to 100 °F (7 °C to 38 °C)

B. Joint Sealing System

Use a joint sealing system designed for HS 20 truck loading and impact according to AASHTO design parameters. Ensure that the system can accommodate the movements indicated in the Plans.

C. Preformed Elastomeric Neoprene Profile Seal

The preformed elastomeric neoprene profile seal shall as a minimum:

- Have the capability to be evacuated of air during installation
- Have the capability to be pressurized with air during the adhesive curing time
- Be compatible with the epoxy and elastomeric concrete header materials (if required)
- Be designed to withstand 50% expansion, 50% contraction (total 100%)
- Withstand the effects of vertical and lateral movements, skew movement and rotational movement without adhesive or cohesive failure.

Ensure the preformed elastomeric neoprene profile meets the requirements of ASTM D 2628.

Ensure the adhesive used with the preformed elastomeric neoprene profile seals is a two-component epoxy based thixotropic paste meeting the seal manufacturer's requirements.

D. Low-Density, Closed Cell, Cross-Linked, Ethylene Vinyl Acetate, Polyethylene Copolymer, Nitrogen-Blown Seal

The low-density, closed cell, cross-linked, ethylene vinyl acetate, polyethylene copolymer, nitrogen-blown seal shall as a minimum be:

- Held in place by a two-component, 100% solid, modified epoxy adhesive.
- Compatible with the epoxy and header materials.
- Preformed, resistant to abrasion, oxidation, oils, gasoline, salt, and other materials that may be spilled on or applied to the surface.
- Grooved, with the grooves approximately 1/8 in. (3 mm) wide by 1/8 in. (3 mm) deep and spaced between 1/4 in. to 1/2 in. (6 mm to 13 mm) apart, and run along the entire length of the bond surface side of the seal.
- Designed so that, when compressed to 50% of original width, the center portion of the top will not extend upward above the original height of the seal by more than 1/4 in. (6 mm).
- Recessed below the riding surface throughout the normal limits of joint movement.
- Resistant to ultra violet rays.
- Beige or gray color.
- Shop marked to indicate the top or bottom side of the seal in such a way as to be clearly visible during installation.

Ensure the low-density, closed cell, cross-linked, ethylene vinyl acetate, polyethylene copolymer, nitrogen-blown seal has a working range of 30% tension and 60% compression.

Ensure the seal meets the following physical properties:

Test	Requirements	Test Method
Tensile Strength	50 psi (345 kPa)	ASTM D3575 (Suffix T)

Elongation at break	255% min.	ASTM D3575 (Suffix T)
Weather/Deterioration	No deterioration for at least 8 years	AASHTO T42 (Accelerated Weathering)
Compression/Deflection	10 psi (69 kPa) min., 60 psi (414 kPa) max. @ 50% deflection of original width	ASTM D3575 (Suffix B)
Tear Strength	13 psi (90 kPa)	ASTM D624
Density	2.8 to 3.4 pcf (45 to 54 kg/m ³)	ASTM D545

The adhesive used with the low-density, closed cell, cross-linked, ethylene vinyl acetate, polyethylene copolymer, nitrogen-blown seals shall be a two-component, 100% solid, modified epoxy adhesive meeting the requirements of ASTM C881, Type I, Grade 2, Class B & C.

The adhesive shall also have the following physical properties:

Tensile Strength	3500 psi (24 MPa) min.
Compressive Strength	7000 psi (48 MPa) min.
Shore D Hardness	75 psi (0.5 MPa) min.
Water Absorption	0.25% by weight

For applications on moist or hard to dry concrete surfaces, the adhesive shall be as specified by the joint material manufacturer.

E. Epoxy Concrete Material

Ensure the epoxy concrete material is as a minimum:

- Compatible with all allowable joint seal materials, and concrete or steel to which it is bonded.
- Capable of providing a smooth riding surface across the joint.
- Capable of being mixed using normal equipment.
- Capable of being mixed and placed at temperatures of 55 °F (13 °C) and above.

Use header material that is a two-component rapid curing epoxy with aggregate that cures to a dense semi-flexible, weather, abrasion, and impact-resistant epoxy concrete.

Ensure the material has the following physical properties:

Test	Requirements	Test Method
Mixed Epoxy without Aggregate: (Before and after oven aging at 158° F (70° C) for 72 hours)		
Tensile Strength (min.)	900 psi (6.2 MPa)	ASTM D 638
Elongation at Break (min.)	40%	ASTM D 638
Shore "D" Hardness	45-75	ASTM D2240
Pot Life (max.)	45 minutes	GDT 111
Mixed Epoxy with Aggregate:		
Compressive Strength at 24 hours (min.)	2,500 psi (17.2 MPa)	ASTM C-39 (3" cylinders)
Resilience at 5% Deflection (min.)	75%	GDT 111
Bond Strength to Concrete (min.*)	375 psi (2.6 MPa)	GDT 111
Wet Bond Strength to Concrete (min.*)	250 psi (1.7 MPa)	GDT 111
Thermal Compatibility	No Delamination	ASTM C 884
*Minimum psi or concrete failure.		

Have the manufacturer furnish the aggregate used in epoxy concrete. Use well-graded, clean and dry aggregate meeting the following gradation requirement:

Size	Percent Passing by Weight
No. 4 Sieve	100
No. 80 Sieve	0-5

Note: Test according to AASHTO T 27.

F. Elastomeric Concrete Material

Ensure the elastomeric concrete material is as a minimum:

- Compatible with all allowable joint seal materials and concrete or steel to which it is bonded.
- Provides a smooth riding surface across the joint.
- Capable of being mixed using normal equipment.
- Capable of being mixed and placed between 45 °F and 100 °F (7 °C and 38 °C).

G. Elastomeric Concrete Cured Binder Material

Ensure elastomeric concrete cured binder material (without filler) has the following physical properties:

Test	Requirements	Test Method
Before oven aging:		
Tensile strength (min.)	750 psi (5.2 MPa)	ASTM D 638
Elongation at break	200 – 350%	ASTM D 638
Hardness Type D durometer	38, ± 8	ASTM D 2240
Compression set, 22 hrs at (max.) 158° F (70° C)	50%	ASTM D 395 Method B
Tear resistance (min.)	150 lbs/in (2.7 kg/mm)	ASTM D 624—2 in/min (50 mm/min)
Water absorption (max.)	1.2%	ASTM D 570
Heat shrinkage (max.)	1.6%	ASTM D 1299
Impact strength (min.)	7 ft-lbs/min (9.5 N ·m)	GDT 111
Properties after oven aging at 158° F (70° C) for 72 hrs:		
Tensile strength (min.)	750 psi (5.2 MPa)	ASTM D 638
Elongation at break	150 – 350%	ASTM D 638
Hardness Type D durometer	42, ± 5	ASTM D 2240
Impact strength (min.)	7 ft-lbs/min (9.5 N ·m)	GDT 111

H. Elastomeric Concrete Binder Material

Ensure that the elastomeric concrete binder material (with filler) has the following physical requirements:

Test	Requirements	Test Method
Resilience at 5% deflection (min.)	80%	GDT 111
Bond strength to concrete (min.*)	375 psi (2.6 MPa)	GDT 111
Wet bond strength to concrete (min.*)	250 psi (1.7 MPa)	GDT 111
Pot life (min.)	5 minutes	GDT 111
*Minimum psi (MPa) or concrete failure		

I. Temporary Joint Filler

Use temporary joint filler when epoxy concrete material is used. The temporary joint filler shall be an extruded rigid cellular polystyrene with enough compressive strength to maintain the correct joint width and to obtain relatively smooth and straight faces upon removal of the material.

449.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

449.3 Construction Requirements**449.3.01 Personnel**

General Provisions 101 through 150.

449.3.02 Equipment

General Provisions 101 through 150.

449.3.03 Preparation**A. Surface Preparation**

Ensure that the compressed air used to sandblast and/or blow debris is free of moisture and oil. Use air compressors for cleaning joints that are equipped with suitable traps capable of removing surplus water and oil in the compressed air. Check the compressed air daily for contamination. Do not use contaminated air. Use a compressor that can deliver compressed air at a continuous pressure of at least 90 psi (620 kPa)..

1. Preparation for Headers

Remove loose, eroded, and unsound concrete from the surface within the joint area. Provide horizontal bonding areas by cutting all angular areas of concrete blockouts. Immediately before placing the epoxy or elastomeric concrete, sandblast the concrete surfaces or abrade free of oil, dust, dirt, traces of asphaltic concrete, or other contaminants.

2. Preparation for Joint Seal

Remove loose, eroded, and unsound concrete from the surface within the joint area. Immediately before placing the seal, sandblast the concrete surfaces or abrade free of oil, dust, dirt, traces of asphaltic concrete, or other contaminants. Saw-cutting of the concrete deck maybe necessary to provide an acceptable attachment surface for the joint seal.

449.3.04 Fabrication**A. Joint Fabrication**

Have the joint fabricated full width of the bridge deck, except in stage construction (one lane at a time) or when joint length prohibits shipment.

449.3.05 Construction

Use an installer trained by the manufacturer to install the bridge deck joint sealing system. A manufacturer's representative shall be present during the installation of the epoxy or elastomeric concrete headers. Install the joint system according to the manufacturer's recommendations and the following:

A. Blockouts

Blockouts shall be according to the Plan details.

B. Weather Limitations

Do not perform any part of the installation in rainy weather or when rain is expected within one hour of installation.

Ensure the surface is completely dry before applying adhesive or primer.

The ambient temperature must not be less than 55 °F (13 °C) during installation of the epoxy concrete material and preformed elastomeric neoprene profile seal.

Ensure the ambient temperature is between 45 °F (7 °C) and 100 °F (38 °C) while installing the elastomeric concrete material.

Ensure the ambient and surface temperatures are between 45 °F (7 °C) and 75 °F (24 °C) while installing the low-density, closed cell, cross-linked, ethylene vinyl acetate, polyethylene copolymer, nitrogen blown seal.

C. General Safety, Handling, Mixing, Finishing, and Curing

Handle, place, finish, and cure elastomeric concrete joint systems according to the manufacturer's instructions and the following:

1. Fill the blockout, as shown in the Plans, to the correct grade.
2. After filling the blockouts on both sides cure the material according to the manufacturer's instructions.

Mix and place the epoxy mortar according to the manufacturer's recommendations and the following:

1. Before adding the aggregate, thoroughly mix the two components (resin and hardener) of the epoxy mortar.
2. Mix the epoxy mortar in a mechanical mortar mixer by combining one volume of mixed epoxy (resin plus hardener in the required proportions) with three volumes of aggregate meeting the requirements of this Specification.
3. Prime the surface of the concrete in accordance with the manufacture's recommendations before applying the epoxy concrete.
4. Place and finish the epoxy concrete within one half hour of mixing.

The cure time of epoxy mortar is directly related to temperature. Use the following table as a general guideline for cure time at various temperatures.

Air and Deck Temperature °F (°C)	Approximate Cure Time (hours)
40 (4)	5
50(10)	4
60(16)	3
70(21)	2.5
80(27)	1.5
90(32)	1
100(38)	0.75

Postpone the installation process if the ambient temperature is not 55 °F (13 °C) and rising. If you cannot postpone the operation, use supplemental heat to complete the operation and reopen the lane in a reasonable time. If using supplemental heat, ensure that the cure has progressed throughout the mass of the header.

D. Mixing and Placing Elastomeric Concrete Material

Handle, place, finish, and cure the elastomeric concrete material according to the manufacturer's instructions. Allow the elastomeric concrete to cool and solidify for at least one hour before opening to traffic.

E. Preformed Elastomeric Neoprene Profile Joint Seal Application

1. After the epoxy or elastomeric concrete has developed enough strength to be traffic ready, remove the temporary joint filler (when called for) and thoroughly clean the joint faces of all joint filler.
2. Lightly sandblast the joint to remove all residue.
3. Apply the adhesive according to the manufacturer's recommendations.
4. Install the preformed elastomeric neoprene profile seal so that it is recessed approximately 1/4 inch (6 mm) below the riding surface.
5. After a joint has been sealed, promptly remove all surplus residue on the bridge deck.

F. Low-Density, Closed Cell, Cross-Linked, Ethylene Vinyl Acetate, Polyethylene Copolymer, Nitrogen-Blown Seal Application

1. After the epoxy or elastomeric concrete (if required) has developed enough strength to be traffic ready, remove the temporary joint filler (when called for) and thoroughly clean the joint faces of all joint filler.
2. Lightly sandblast the joint to remove all residue.
3. Apply the epoxy adhesive to both sides of the joint opening and into the grooves of the joint seal material.
4. Splice the seal using the heat welding method by placing the joint seal material ends against a Teflon heating iron of 350 °F (177 °C) for 7-10 seconds and pressing the ends together tightly.

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5. Install the joint seal material in one piece.
6. Begin installation at the low end of the joint. Install the joint seal material by compressing the material and pushing it down into the joint opening until it has recessed approximately 1/4 inch (6 mm) below the deck surface. Do not push the joint seal material into the joint at an angle that will stretch the seal material.
7. Once installation of the joint seal material has begun, do not stop the process until it has been completed.
8. Immediately and thoroughly clean off excess epoxy from the surface of the joint material. Do not use solvents to clean the top surface of the joint seal material

G. Opening to Traffic

Do not permit traffic to drive over sealed joints until the epoxy or elastomeric concrete has hardened enough to resist displacement of the seal due to deck movement or other causes. Allow the elastomeric concrete to cool and solidify for at least one hour before opening to traffic. Allow the epoxy concrete to cure for at least two hours before opening to traffic.

449.3.06 Quality Acceptance

A. Acceptance

Provide evidence from the manufacture that the joint system has been used successfully in installations with similar environmental and project conditions. Failure to perform adequately in actual use shall be cause for rejection.

B. Correction of Defects

At the Contractor's expense, repair, or remove and replace, joint seals that are complete and have leaks, have adhesive or cohesive failure, or that are damaged during construction or by traffic before final acceptance.

449.3.07 Contractor Warranty and Maintenance

To comply with Subsection 106.05, "Materials Certification," provide certification from the manufacturer that shows that the bridge deck joint sealing system materials conform to the requirements stated in Subsection 449.2. Transfer to the Department the manufacturer's standard five-year performance warranty on each installation. A warranty claim may be filed for cohesive or adhesive failure of the materials supplied or material failure due to weathering.

449.4 Measurement

When listed as a pay item in the Proposal, bridge deck joint seal will be measured and paid for at the Contract price linear foot (meter) complete in-place joint at the location specified on the Plans. Payment is full compensation for the removal of any old sealant, cleaning the joint, and furnishing and installing the new seal and header if required and all incidentals.

No separate measurement and payment will be made unless a pay item for the work is included in the Proposal. If no pay item is included in the Proposal, the cost of the joint seal shall be included in the overall bid price submitted.

No separate measurement or payment will be made for any saw-cutting required to install the joint.

449.4.01 Limits

General Provisions 101 through 150.

449.5 Payment

When shown in the schedule of Items in the Proposal, the following items will be paid for separately:

Item No. 449	Performed Elastomeric Neoprene Profile Joint Seal with Epoxy Concrete Headers Bridge No. _____ Bent No. _____	Per linear foot (meter)
Item No. 449	Performed Elastomeric Neoprene Profile Joint Seal with Elastomeric Concrete Headers Bridge No. _____ Bent No. _____	Per linear foot (meter)
Item No. 449	Low-Density, Closed Cell, Cross-linked, Ethylene Vinyl Acetate, Polyethylene Copolymer, Nitrogen-Blown Seal with Epoxy Concrete Headers Bridge No. _____ Bent No. _____	Per linear foot (meter)
Item No. 449	Low-Density, Closed Cell, Cross-linked, Ethylene Vinyl Acetate, Polyethylene Copolymer, Nitrogen-Blown Seal with Elastomeric Concrete Headers Bridge No. _____ Bent No. _____	Per linear foot (meter)
Item No. 449	Low-Density, Closed Cell, Cross-linked, Ethylene Vinyl Acetate, Polyethylene Copolymer, Nitrogen-Blown Seal Bridge No. _____ Bent No. _____	Per linear foot (meter)
Item No. 449	Elastomeric Profile Bridge Joint Seals, Bridge No. _____ Bent No. _____	Per linear foot (meter)

449.5.01 Adjustments

General Provisions 101 through 150.

Section 450—Pressure Grouting Portland Cement Concrete Pavement

450.1 General Description

This work includes pumping a slurry type grout mixture through holes drilled in the pavement into voids underneath the slabs to stabilize and underseal Portland cement concrete pavement.

Use a grout mixture that can form a hard and durable mass to fill voids under the pavement. Regrout unstable slabs after initial undersealing and stabilizing as directed by the Engineer.

450.1.01 Definitions

Initial set: 200 psi (1380 kPa) with a 0.25 in² (161 mm²) probe according to AASHTO T 197 (Proctor Needle Test).

450.1.02 Related References**A. Standard Specifications**

Section 452—Full Depth Slab Replacement

Section 609—Removal of Portland Cement Concrete Roadway Slabs

Section 801—Fine Aggregate

Section 830—Portland Cement

Section 831—Admixtures

Section 880—Water

Section 882—Lime

Section 883—Mineral Filler

Section 884—Chlorides

B. Referenced Documents

GDT 84

AASHTO T 197 (Proctor Needle Test)

450.1.03 Submittals

General Provisions 101 through 150.

450.2 Materials**A. Fine Aggregate**

Ensure that fine aggregate meets the requirements of Subsection 801.2.02, except mortar-making properties are not required.

B. Grout Mixtures

The Bid Item designates the required undersealing grout mixture types. The mixture contains the proportions listed in the Table of Grout Mixtures below.

Use enough mixing water with the dry ingredients to produce a grout consistency that makes the efflux time from the flow cone at least 14 seconds and no more than 20 seconds. Use GDT 84 to determine the grout consistency.

Add cement, cement and limestone dust, cement and fly ash, or cement and fine aggregate in the proper proportions to a mixed batch to produce the required consistency.